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Georgia's Future Timber Supply

An Economic Outlook

By
Albert A. Montgomery
& Vernon L. Robinson

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Georgia's Future Timber Supply

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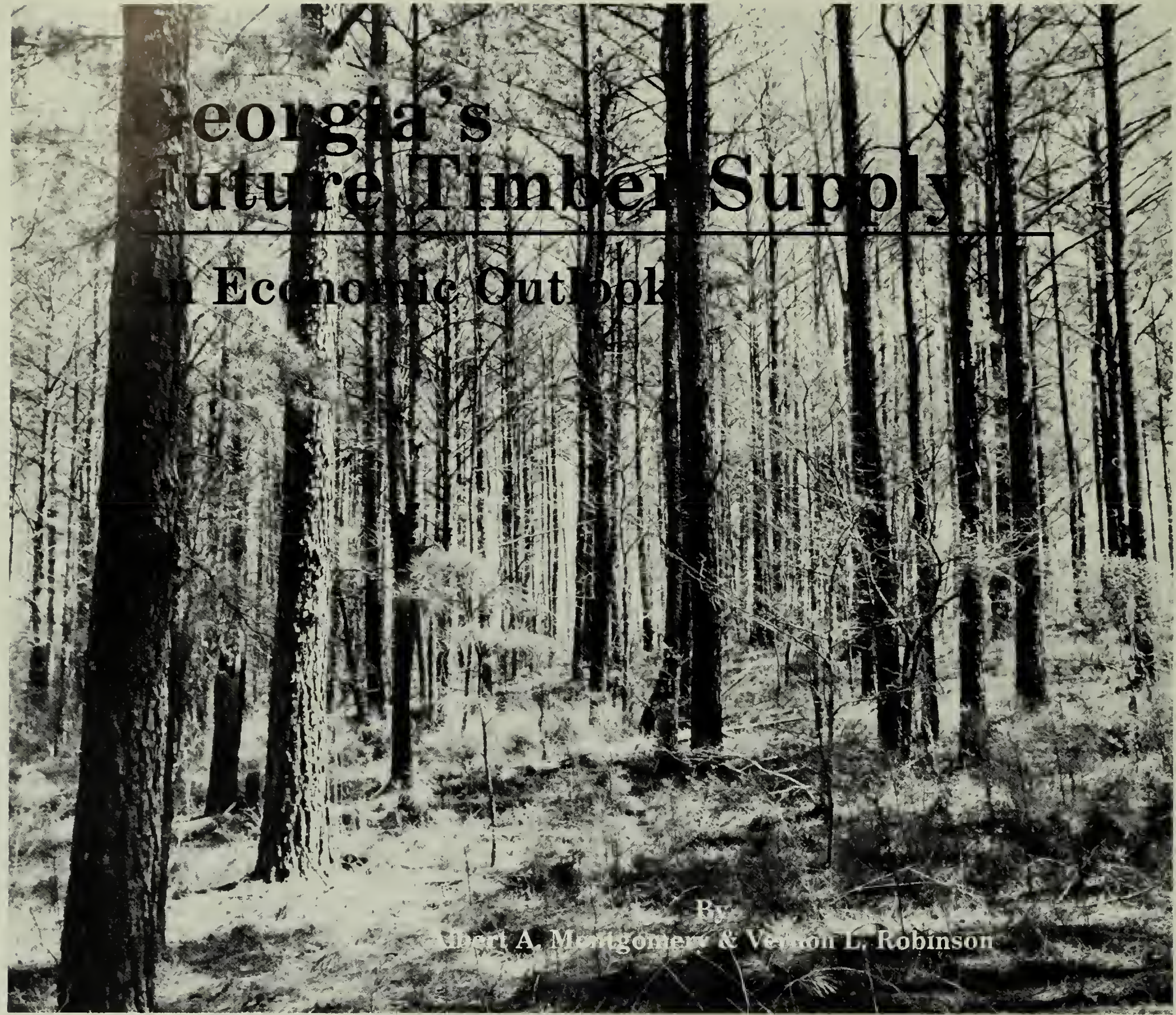


Stumpage prices in Georgia have increased rapidly, making forestry investments more profitable.

Abstract

Powerful cross currents in the economy have created considerable uncertainty about the future of Georgia's forest resource. This study provides an economic outlook for Georgia's pine forest with which to evaluate its long run future. Among the findings is that the long run costs of supplying pine timber from Georgia have increased substantially in recent history due to general price inflation. But stumpage prices in Georgia have increased more rapidly, making forestry investments more profitable. There has been a growth in industry demand for pine stumpage from Georgia. By 1984 industry's timber demand was pressing not only against the limit of the forest's net annual growth but also against the volume that could be supplied over the long run at 1984 costs and prices. Thus, Georgia's supply of pine timber is more limiting than industry demand in regard to continued growth of the forest economy. Moreover, the annual acreage of pine regeneration required to sustain existing industry timber demand is several times the annual acreage of pine plantations found by the 1982 forest survey for the previous decade. More recently, due to the concerted effort of public and private agencies, the annual planting acreage may be sufficient to sustain the existing industry capacity, if not continued growth in that capacity. The best hope for substantial continued growth in the long run supply of pine timber from Georgia is the diversion of marginal and idle farmland to forestry. At current stumpage prices as much as 22 percent more pine timber could be supplied to market, the equivalent of 4 to 5 new world class pulp mills, if an estimated 1.7 million acres of marginal and idle cropland is planted to pines. While it is problematical that the federal Conservation Reserve Program will be funded sufficiently to finance such a large plantation of farmland, there is a strong economic motive for farmers to plant pines on their marginal land. This motive is that the bare land value of timberland is surprisingly high in relation to farmland values. By this study's analysis there are 3.6 million acres of rural land with a bare land present value of more than $600 an acre and almost a half million acres with a bare land value of more than $1,000 an acre, assuming the land will receive forest management appropriate at 1984 costs and prices.

Introduction

Powerful cross currents in the economy have created considerable uncertainty about the future of Georgia's forests. In recent years the outlook for forestry in Georgia has been buoyed by a strong domestic demand and a growing export demand for Georgia's forest products. But these favorable market developments are being offset, if not swamped, by a flood of lumber imports and by growing competition in the world market for wood pulp. Similarly, on the timber supply side, the recent enactment of a new federal Conservation Reserve Program promises pine plantations on hundreds of thousands of new timberland acres diverted from agricultural cropland use. But, as a countervailing influence, the Tax Reform Act of 1986 has taken away some tax incentives for forestry investment on existing timberland.

No one can predict how these conflicting forces will shape the future Georgia forest. But it can be said that these and other important influences will work out their mutual effect upon the future forest through their impact upon the outlook as to what should be the future forest. To a large extent the outlook for the future forest that comes to be accepted by industry, state and federal policy makers, timberland owners, and all other interested parties, is a self-fulfilling prophesy.

If it is the concensus of opinion that these recent developments, on balance, will diminish the future forest in Georgia, the immediate effect will be that timely investments will not be made in pine plantations and other forest practices. As existing stands of pine trees are cutover, and not replaced, in much of Georgia less desirable hardwoods will subsequently invade the vacated pine sites. Consequently, the Georgia forest of the future in fact will be diminished with all that entails for the important manufacturing and other economic sectors in Georgia that are supported by the forest resource. Therefore, everyone with an interest in the forest should have access to an economic outlook providing the best possible answers to the following questions.

How much of Georgia's timberland should be available for growing timber in the long run and how much should be left for other uses such as wilderness and outdoor recreation? How should the timberland that is needed for timber growing be managed as it lays in various ownerships, forest types, physiographic classes, site qualities, and localities? How many acres should be regenerated and managed as pine plantations as compared with the alternatives of natural stand management, which uses seed trees for regeneration, or that of custodial care, where regeneration is left to nature and management is limited to a cutting cycle? Further, how much sustained annual harvest should be supplied the timber market in the long run and what should be the species and product composition of the annual harvest volume?

By the same token, the economic outlook for the timber supply should implicitly answer questions of the individual landowner. When should he harvest his timberland and which of several management alternatives should he choose? Should he clearcut the existing stand of timber and then invest part of the proceeds in site preparation and planting of pines? Should he reserve seedtrees from the harvest and plan to intensively manage the stand that arises naturally? Should he clearcut and let nature take its course in the hope that hardwoods will not invade the site in lieu of pine regeneration? Or should the owner forego forestry altogether after this timber harvest and apply his land to agricultural or real estate uses?

If the timber supply outlook is to address adequately the questions of public policy makers and individual landowners it must be based upon sound principles of forestry and economics. The recommended silvicultural practices must be proven in general use and the associated timber yields must be achievable on the broad reaches of the state's landscape and not merely on controlled experimental plots. Similarly, the outlook should take systematic account of inflation and competing economic resource uses and expound economic recommendations that are approximately optimum both as applied to individual landowners and the forest generally. Finally, since the outlook's

Table 1

Area of Commercial Forest Land in Georgia
By Forest Type, Ownership, Site Class, and Physiographic Class

	1972		1982	
	Acres	% Distr.	Acres	% Distr.
Forest Type				
Natural Pine	9,475,016	38.1	7,846,764	33.1
Planted Pine	2,850,104	11.5	3,592,155	15.1
Oak-Pine	4,142,810	16.7	2,959,550	12.5
Upland Hardwoods	5,170,805	20.8	5,805,257	24.5
Bottomland Hardwoods	3,200,248	12.9	3,529,958	14.8
Total	24,838,983	100.0	23,733,684	100.0
Ownership				
Public	1,571,635	6.3	1,583,762	6.7
Industry owned & leased	5,239,065	21.1	5,936,248	25.0
Other Private	18,028,283	72.6	16,213,673	68.3
Total	24,838,983	100.0	23,733,684	100.0
Site Class				
High	6,588,229	26.5	8,455,485	35.6
Average	16,687,066	67.2	13,895,937	58.6
Low	1,563,688	6.3	1,382,262	5.8
Total	24,838,983	100.0	23,733,684	100.0
Physiographic Class				
Xeric	1,887,251	7.6	1,466,484	6.2
Mesic	19,909,815	80.2	19,800,631	83.4
Hydric	3,041,917	12.2	2,466,569	10.4
Total	24,838,983	100.0	23,733,684	100.0

SOURCE: U. S. Forest Service

Table 2

Prescribed Management for Equilibrium between Supply and 1984 Prices
($542/MCF Level of Prices and Costs and 963.2 Million Cubic Foot Volume)

	Managed Area				
	Plantation M Acres	Nat. Std. M Acres	Custodial M Acres	Total M Acres	Unmanaged Forest M Acres
Region					
Coastal	5,062.7	48.1	671.5	5,782.3	86.1
Piedmont	2,579.0	1,623.6	43.8	4,246.3	1,832.2
Mountain	.0	72.9	26.0	98.9	1,051.5
Ownership					
Public	433.3	175.4	94.4	703.1	87.8
Industry	2,702.4	21.1	84.6	2,808.1	1,217.4
Other Private	4,506.0	1,548.1	562.3	6,616.3	1,664.6
Forest Type					
Longleaf-Slash	3,954.6	.0	163.5	4,118.1	360.5
Loblolly-ShtLf	2,894.5	1,744.6	.0	4,639.1	1,490.3
Oak-Pine	792.6	.0	577.8	1,370.3	1,119.0
Physiographic Class					
Xeric	147.8	17.0	72.5	237.3	173.6
Mesic	7,426.8	1,710.3	527.4	9,664.5	2,763.3
Hydric	67.1	17.3	141.4	225.7	32.9
Site Class					
High	4,764.0	72.9	26.0	4,862.9	323.9
Medium	2,876.6	1,631.7	505.5	5,013.7	2,383.6
Low	1.1	40.0	209.8	250.9	262.3
State Total	7,641.7	1,744.6	741.3	10,127.5	2,969.8

Authors' computations

validity depends upon silvicultural and economic assumptions that are arguable and subject to change, it must allow them to be changed easily and at low cost.

Such an economic outlook has been available to Georgia for a number of years. In culmination of several years of research, the authors prepared a computer model of the economic outlook for the forest resource not only in Georgia but in the five southeastern states of Florida, Georgia, North and South Carolina, and Virginia. This earlier study was conducted under the auspices of the U. S. Forest Service, Georgia State University, and the Coastal Plains Regional Commission and was completed in 1979. This study will update the data inputs of this computer model using Georgia's 1982 Forest Survey and management costs and stumpage prices prevailing in 1984. This more recent timber supply outlook will then be compared with the earlier one and with alternative "what if" outlooks analyzing the impact of selective changes in the model's assumptions.

Methodology

Timberland

The forest's sustained annual yield or harvest is importantly determined by the available timberland and its various characteristics. Acreage estimates of the various classifications of Georgia's timberland are found in the periodic forest surveys undertaken by the U. S. Forest Service, Table 1.

Both this and the earlier timber outlook study are based upon special computer runs of forest survey acreages as subdivided into hundreds of classification cells. Each of these acreage cells is identifiable as to its location in one of the state's forest survey units, the coastal, piedmont, or mountain regions, its forest type, ownership, productivity class, and physiographic class.

Five forest types are recognized, longleaf-slash pine, loblolly-shortleaf pine, oak-pine, upland hardwoods, and bottomland hardwoods. In Table 1's compilation of statewide totals, the acreage of the two pine forest types have been recombined into the total pine forest found in natural stands and plantations. While the long-run supply of timber is the sustained harvest that can be grown on the land by proven silvicultural methods and does not refer to the existing stands of trees, as such, the practice of pine silviculture is greatly facilitated on land that is presently in pine forest types. Therefore, it is significant for the long-run supply of pine timber that the acreage of Georgia's natural and planted pine forest declined by almost 900,000 acres between 1972 and 1982. Similarly, while the practice of pine forestry is more difficult and costly on land with mixed stands of hardwood and pine, Georgia's future pine timber supply has been severely circumscribed by the loss of almost 1.2 million acres of the oak-pine forest type between the 1972 and 1982 surveys.

This more than 2 million acre loss of forest land suitable for pine forestry partially reflects diversion to other land uses, as reflected by the decline of the total forest from 24.8 million to 23.7 million acres. But it also reflects the reversion of 1 million acres of forest land to hardwood forest types, which are of limited value as a raw material source for Georgia's forest industry and which are economically unfeasible for reconversion to pine forestry.

The woodland owner has a significant impact on the types of forest management practiced and their costs. Three owner groups are identified; public, including federal, state, and local government land, forest industry, including land leased by industry, and other private ownership, including farmers, other individuals, and corporations. The slight increase in the share of timberland owned or leased by industry, from 21.1 percent in 1972 to 25.0 precent in 1982, will be a positive factor influencing the timber supply outlook in the 1980s as compared with the earlier outlook.

Three timber site productivity classes are used to account for differences in timber yield attributable to forest land quality. High site land, according to forest survey standards, is capable of producing one to two cords per acre per year if fully stocked in natural stands. An average site has a productivity of about one-half to one cord per acre per year and a low site is incapable of producing even a half cord per acre per year. Between the 1972 and 1982 surveys there has been an apparent reclassification of almost 2 million acres from average to high site quality.

Finally, each of the acreage classification cells will be identifiable according to its physiographic class in recognition of cost limitations imposed by wetlands, i.e. hydric land, or by dry, steeply sloping land, i.e. xeric land. It is seen that Georgia's timberland is primarily of the mesic, or more easily managed physiographic type. Further, most of the more difficult to manage land is associated with hardwood forest types, land which will not be included in the pine forest outlooks.

Land Availability Adjustments

The land area recognized by the forest survey as commercial forest today has been adjusted for prospective changes in land uses that may occur over the near future. The prospective population growth in each of the three sub-state regions implies loss of commercial forest to urban-related uses such as home sites, shopping centers, industrial parks, road and utility rights-of-way, airports, sanitary landfills, parks, and so on. It is projected to the early years of the next century that the coastal plain region will lose about 155,000 acres, the piedmont region about 880,000 acres, and the mountain region 105,000 acres of commercial forest, including hardwood forest types. Not all of this acreage will be physically lost from the forest but will be economically and legally unavailable for forestry. For every acre that will be developed for urban uses, several acres will be held in speculation of that development, as the urbanizing process casts a land price shadow through the real estate market. The fractionization of landholdings into small parcels which accompanies urban development also encourages recreational and environmental uses of the land at the expense of forest management.

Much of the existing forest in Georgia came into being on abandoned farmland. By the early 1970s the reversion of farmland to forest had largely run its course. But the economic model of the timber supply outlook allows for a continued shift of land from agriculture to the forest as well as allowing for the conversion of cutover timberland to agricultural uses. The land that can shift back and forth between forestry and agriculture includes high site quality, mesic terrain land in farmer ownerships presently included in the commercial forest and agricultural land presently idle or in row crops, a total of almost 2.0 million acres.

Within the limits of this contested land, the model recognizes agricultural rent as an opportunity cost for forestry. The per acre annual rent in the 1980s timber supply outlook is assumed to be $18.50 in the coastal region, $15.50 in the piedmont, and $6.50 in the mountains. In the 1970s outlook the annual agricultural rent in the three regions was assumed to $22.70, $18.30, and $10.60 respectively. The opportunity to earn an agricultural return on timberland is calculated net of the heavy land clearing cost, estimated to be $425 per acre in 1984 constant dollars. Conversely, the contested land presently in agriculture has as its opportunity cost the economic return that could be earned from pine forestry. This forestry return is calculated net of a moderate site preparation and planting cost, $85 an acre. In general, the higher the level of stumpage prices that is contemplated for the future, the greater the acreage shifting to forestry from agriculture and vice versa, when lower future stumpage prices are anticipated.

Finally, the commercial forest in Georgia has been reduced by more than 2 million acres in recognition of the inaccessibility of the land and the difficultry of road building and operations. The impact of this adjustment is primarily upon hardwood forest types, the acreages of which are not included in the pine economic outlook.

Management Plans and Timber Yields

In the long run the timber harvest that can be sustained by the Georgia forest depends not only upon the availability and quality of land in forestry, but upon the type of management that is applied to that land. A choice of three, even-aged, area-controlled management plans can be applied to the acreage cells described above: plantation, natural stand, and custodial. The model also allows for a choice between shorter and longer rotations within each plan.

The pine plantation option is available to the two pine forest types and the oak-pine forest type in the coastal and piedmont regions of the state, but not the mountains. The practices of this plan consist of site preparation, planting, prescribe burning, one or more commercial thinnings, and a final harvest. The model chooses between a 25 year and a 35 year rotation on private land and 50 and 70 years for public land.

The natural stand option for pine management assumes that seed trees will be reserved from the harvest of existing stands to provide a crop of seedlings. Subsequent practices include a timber stand improvement immediately after harvest to remove the overstory of hardwoods and a precommercial thinning to shape the stand at 500 to 600 trees in the fifth year of the rotation, when the seed trees are removed.

The custodial management option exemplifies the management or, more accurately, the lack of management that established the currently existing forest in the largest part of Georgia. Custodial management implies that, after existing trees are harvested, the regeneration and subsequent growth of the stand is left to nature with man's intervention limited to overseeing and government protection against fire, insects, and disease. The harvest or cutting cycle of this option is much longer than the other two plans because of the delay in establishing a viable stand of pine. Notwithstanding its obvious liabilities for pine management, under certain circumstances the custodial option will be economically preferred over the other two plans.

The timber yields that are appropriate for each management plan vary according to species, site quality of the land, geographic location, the intensity of management, and length of rotation period. The plantation yields for both slash and loblolly pine are calculated from the old-field yield equations of Coile and Schumacher (1964), assuming an approximate initial 8 by 10 foot spacing with 500 trees per acre surviving at age five. The pine yields for the natural stand management option are from the natural stand equations of Schumacher and Coile (1960), assuming a 90 percent stocking level to reflect an uneven seed catch. The natural stand yields for the oak-pine forest type and the custodial option yields for all forest types are from studies by Knight (1978). In general these yield estimates were chosen to reflect the reality of the forest's annual growth potential as the forest presently lies in broad areas.

Management Costs and Stumpage Prices

The annual volume of timber that can be harvested for the stumpage market over the long run will depend not only upon the available land upon which to grow the timber and the manner in which the land is managed but also upon forestry's economic costs and returns. The money and implied costs of the management practices of each plan must be accounted for and compared with the money returns that can be earned from the stumpage market at various levels of stumpage prices. Pine plantation site preparation and planting costs in the 1980s range from $100 to $260 an acre in the coastal plain and from $150 to $210 an acre in the piedmont, generally about 75 percent higher than in the 1970s. The remaining costs of management include those of prescribe burning, timber stand improvement practices, the annual ad valorem property tax at per acre rates of $4.00 and $5.50, and $5.80 in the three regions, annual overhead costs of $4.00 and $5.00 per acre on industry and public lands, the costs of marking and administering commercial thins and final harvest, and the opportunity cost of capital (i.e., interest) at "real" rates of 3, 4, and 5 percent as applied to public, industry, and other private land, respectively. All costs are expressed in constant dollars at 1984 prices for the timber supply outlook of the 1980s. The outlook for the 1970s expressed its costs in constant 1977 dollars. By the same token, stumpage prices are not increased in anticipation of future inflation.

The per acre of the timber yield from each plan as found for each acreage component is matched against the per acre return as found by multiplying the pulpwood, chip-n-saw, and sawtimber components of the timber yield by appropriate stumpage prices. The price data have been obtained from *Timber Mart-South* (1976-78, 1984) and comprise a constellation of prices, varying between the three sub-state regions as well as by product. These price data are expressed relative to each of a number of price "levels" or "averages". It will be seen that the stumpage prices are expressed in dollars per thousand cubic feet of timber yield, \$/MCF. The thousand cubic foot measure is equivalent to 5,464 board feet of sawtimber or 10.87 cords of solid pulpwood.

Management Choice Criterion

The model's choice of which of the available management plans that will be applied to each of the acreage cells comprising Georgia's commercial forest area depends upon which plan promises the landowner the maximum present net worth of his investment. This profit-maximizing criterion yields equivalent recommendations as that of maximizing the internal rate of return. The general formula for calculating present net worth, Vp, is as follows:

$$V_p = \frac{P_nQ_n - (C_a(1+i)^{n-a} + F[\frac{(1+i)^n-1}{i}] - P_bQ_b(1+i)^{n-b})}{(1+i)^n-1}$$

Where:

P_nQ_n = revenue from the final harvest
P_bQ_b = revenue from intermediate thinning of pulpwood in bth years
F = annual fixed or overhead costs
C_a = management costs as incurred in ath years
n = number of years in the rotation period
i = interest rate or capital cost
a = ath year after beginning of rotation period, year a, varying from 1st to nth year
b = bth year after beginning of rotation period, year b, varying from 1st to nth year

Although the computer will be making thousands of these present net worth calculations, the large majority will merely involve iterative changes in Pn and Pb, the prices applying to final harvest and commercial thinnings.

The numerical result of the present net worth calculation made for each alternative management plan available to each of the hundreds of acreage cells comprising the forest will either be a positive number, a negative number, or zero. If the result is a negative number, that particular management plan will be rejected for the acreage cell in question. If all three management options available to an acreage cell have negative present net worths, the land area of that cell will not be included in the manageable acreage of the forest at the level of stumpages applying in the calculation. On the other hand, if the present net worth calculation is positive for a particular management option, it signifies that the option is profitable. But this does not mean that the option will be chosen. One or both of the other plans may yield a higher profit, in which event the model will choose the plan that is the most profitable, thus maximizing the landowner's economic return.

Present net worth is the dollar amount the landowner could pay per acre today for the land bare of trees, assuming he is willing to earn a rate of return on the recommended investment in management practices equal to the interest rate, i.e. i in the above equation. Thus, if the indicated present net worth per acre is zero, the landowner could not afford to pay anything for the land in order to practice forestry on it but if he already owns the land, forestry would offer as good an investment opportunity over long run as offered by the economy. If the indicated present net worth is positive and the land is already owned, it signifies that forestry will yield an above average investment return to the landowner.

Findings

The long run supply curve representing the 1980s baseline timber supply outlook is displayed on a graph in the price-quantity plane, Chart 1. Shown as a solid upward sloping line, this supply curve is compared with a dotted line representing the supply curve taken from the 1970s timber supply outlook, Chart 2. Within the range of realistic stumpage prices, say from \$200 to \$800 per MCF, it is seen that the more recent timber supply curve is significantly higher and to the left of the earlier supply curve. Alternatively, in Chart 2 it is seen that the solid line representing the supply curve of the 1970s outlook is significantly lower and to the right of the dotted line representing the more recent supply curve. From whichever angle it is viewed, there has been a substantial increase in the per MCF (unit) costs of supplying pine timber between the outlook made with data from the 1972 Forest Survey and 1977 prices and costs and that with 1982 Forest Survey and 1984 prices and costs. Two factors explain this increase in costs, changes in land availability recorded in the 1982 forest survey from that of 1972, and the inflation of management practice costs between 1977 and 1984.

With regard to changes in the land available for pine forestry, as noted above, there were about two million fewer acres of the pine and oak-pine forest types reported for 1982 by the Survey than for 1972. This development tends to shift the supply curve to the left. This diminution of the land area available for pine forestry due to the invasion of hardwoods and loss to competing land uses is offset in part, however, by the reclassification of average site pine land to high site pine land and by the greater availability of agricultural land in the 1980s outlook. These latter changes would tend to shift the supply curve to the right. Importantly contributing to the increasing unit costs or leftward shift in the timber supply curve was the rising per acre cost of management practices due to the general price inflation of the late 1970s and early 1980s. On balance, therefore, at any reasonable expected price level it is seen that it would cost significantly more per MCF to supply an equivalent volume of timber in the 1980s outlook than in the 1970s outlook.

In compensation for the increasing unit costs due to inflation and land lost to hardwood invasion and competing land uses in the 1977-84 period was the concurrent inflation of stumpage prices. Indeed, the level of stumpage prices in Georgia increased over this period apparently more than in proportion to the unit costs of supplying timber to the market over the long run. Observe in Chart 1 that the long run equilibrium volume of 963 million cubic feet has a cost of \$542/MCF, just equal to the 1984 price level of \$542/MCF. The cost of this volume is about 50 percent higher than what that volume would have cost in 1977, as represented by the dotted line at that volume. But over the same period the level of stumpage prices increased from \$336/MCF to \$542/MCF, or more than 60 percent. This relatively greater increase in prices means that the per acre profit or present net worth of forestry investments has generally increased since the 1970s. Also indicative of the increased profitability of forestry in Georgia is the fact the volume of timber that could be supplied the market in the long run at the \$336/MCF price level of 1977 was 863 million cubic feet, 100 million cubic feet less than the volume that could be supplied economically at the 1984 price level of \$542/MCF.

That unit costs did not rise as much as stumpage prices reflects to a small extent the facts noted above, relatively more high site quality acres due to the Survey reclassification of timberland and greater availability of agricultural land. But these supply side cost compensations do not explain the significant rise in stumpage prices. For that matter, neither does the general price inflation in the economy wholly explain the rise in stumpage prices. From 1972 to 1982, and even from 1977 to 1984 there was a substantial increase in the real demand for timber in Georgia due to the expansion of the forest industry in the state. Stumpage prices have tended to rise somewhat faster than general price inflation due to this expanding industry demand.

Significantly, the volume of industry's timber demand already existing in 1984 closely approximated the sustained annual yield that could be supplied from Georgia's pine forest over the long run at the stumpage prices prevailing in that year. The demand-supply equilibrium at $542/MCF calls for a sustained annual pine yield of 963 million cubic feet. The 1982 Survey reported 960 million cubic feet of softwood removals. Granted some noncommercial timber removals are included in the latter, the existing industry demand already is pressing upon the limits of the timber volume that can be supplied from Georgia's forest over the long run at existing prices and costs.

This was not the case in the 1970s timber supply outlook. Note in Chart 2 that the 863 million cubic foot volume that was the equilibrium between long run supply and the 1977 level of stumpage prices is about 200 million cubic feet greater than the actual volume of softwood removals in 1972. The growth of installed industry capacity in Georgia in the 1970s and early 1980s has more than taken up that slack.

Also, it is interesting that the recent growth of the forest product industry in Georgia has pushed stumpage demand to a level in the 1980s that was visualized in the 1970s for the year 2000. The conventional downward sloping demand curve in the 1970s outlook assumes a doubled demand for stumpage by the year 2000 from the level of 1972 removals, as was generally projected in the 1970s. At 1977 stumpage prices and management costs this version of long run demand called for a sustained annual yield or harvest of 1,076 million cubic feet for the year 2000 and beyond. Applying that same demand curve in Chart 1's baseline 1980s outlook results in some indeterminancy due to the model's technical limitations. But at 1984 management costs and yields it is seen that the equilibrium of supply and the downward sloping demand curve tends toward the point of intersection between 1982 softwood removals and 1984 prices.

Of course, a different future demand scenario than the two approaches used here could call for a larger long run annual yield or harvest for Georgia. But note this can be accomplished only at sharply higher stumpage prices due to the upward sloping timber supply curve. Whether or not the forest products industry would be willing to substantially expand its capacity in Georgia at a much higher level of stumpage prices than prevails today is a question beyond the scope of this study. But it appears clear that it is timber supply, more than industry demand, that presently limits the potential expansion of the annual growth and harvest of pine timber in Georgia.

Equally important, it is not a sure thing that even the 1982 volume of removals can be sustained over the long run. This depends upon whether the forest is being managed today in a fashion that will accomplish this volume of annual growth over the long run. The model's management curve for the timber market equilibrium of the long run supply and the stumpage price level of 1984 is summarized in Table 2.

After allowance for the loss of timberland for various reasons noted above, slightly more than 13 million acres of pine and oak-pine land is available to Georgia's future forest. At the $542/MCF level of stumpage prices and the recent level of agricultural returns, no more timberland would be lost to agriculture. Of the 10.1 million acres recommended for one of the three management plans, 7.6 million acres yield maximum economic returns under plantation management and 1.7 million acres are best managed under an intensive natural stand regime. Only 741.1 thousand acres are indicated for custodial or cutting cycle management.

Under even age management, largely on a 35 year rotation, 222 thousand acres would be planted each year under the recommendations of this timber supply outlook. This is several times the annual planting acreage found by the Survey over the period from 1972 to 1982. In the past several years, as a result of a concerted effort by public and private agencies, the estimated annual plantings in Georgia appear to be meeting this acreage requirement. But any future letdown from this extraordinary effort to regenerate Georgia's pine forest will jeopardize the volume of growth and harvest needed to sustain the existing capacity of the forest products industry.

As seen in Table 2, there are 2,969.8 thousand acres in this timber supply outlook that are classified as unmanageable. By this is meant that this marginal land would not earn enough from any of the three management plans to cover the cost of the annual ad valorem property tax at the 1984 level of stumpage prices. At a higher level of stumpage prices much of this land would be manageable. Moreover, as will be seen, even without a future increase in the level of stumpage prices, much of this land would be manageable under different assumptions concerning interest rates and agricultural rents.

Chart 1

Georgia's Long Run Pine Timber Supply
(1980s Baseline Outlook)

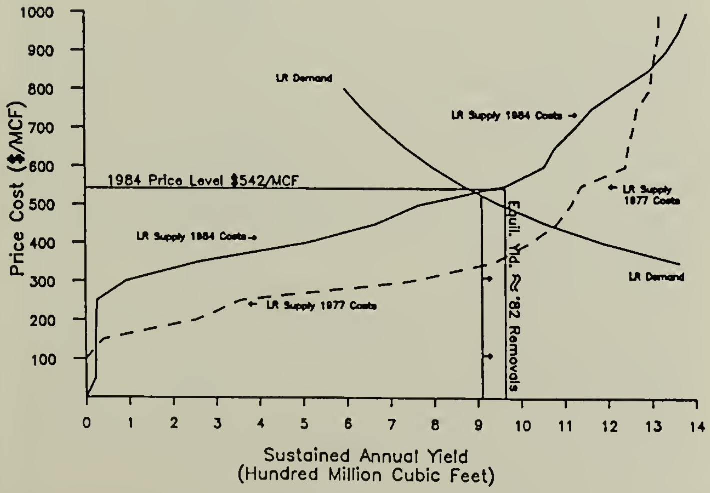


Chart 2

Georgia's Long Run Pine Timber Supply
(1970s Outlook)

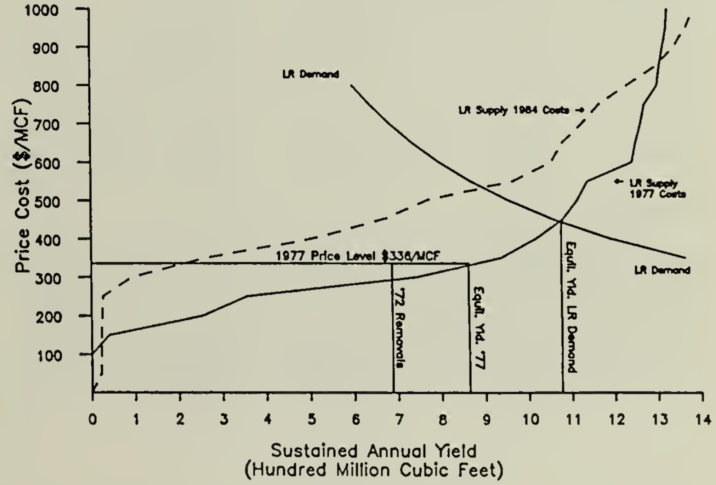


Chart 3

1980s Outlook With $1 Per Acre Agricultural Rent
(Conservation Reserve Outlook)

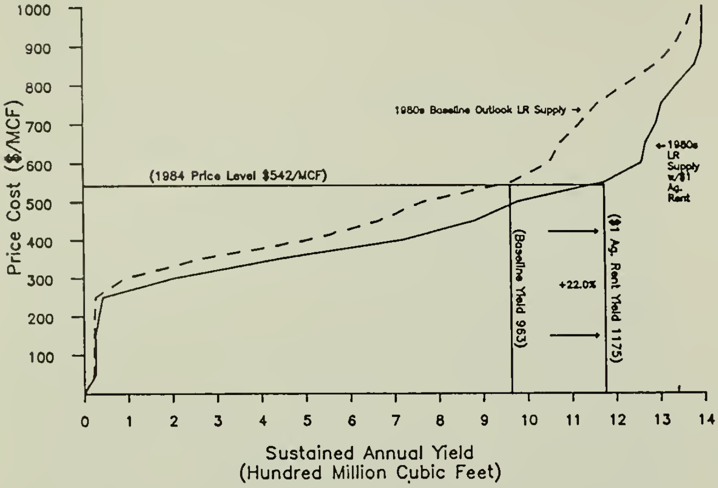
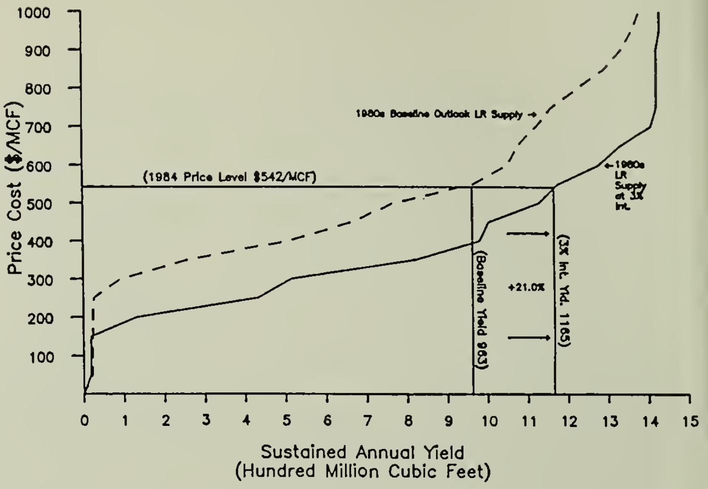


Chart 4

1980s Outlook With 3 Percent Interest Rate
(Public Interest Outlook)



The "What If" Agricultural Outlook

Recently, agriculture's prospects have darkened to the point where it is questionable that the agricultural rents are as high as assumed in the model for much of the land competing with forestry. Even to the extent the land will yield the indicated agricultural rent, the recently enacted Conservation Reserve Program offers to pay the rent on as much as 1 million acres of the state's cropland if it is diverted to forestry. This much acreage plus that estimated to be in idle agricultural land has been included in the model. To assess the potential impact of a diversion of this much land from agriculture to forestry, the timber supply outlook in Chart 3 assumes that the annual land rent to be earned in all three regions is a nominal $1 per acre, as compared with $18.50, $15.50, and $6.50 per acre assumed in the above outlook.

In this "what if" scenario all other assumptions remain unchanged so as to isolate the impact of this one change on the timber supply. The resulting timber supply curve is seen to be substantially to the right of the dotted line representing the supply curve of the 1980s outlook in Chart 1. This means that far more timber volume could be supplied to the stumpage market over the long run at any of a wide range of stumpage prices. At the $542/MCF or 1984 price level the equilibrium volume increases by 212 million cubic feet per year or 22 percent to 1,175 million cubic feet. This expansion of the timber volume that could be supplied to the market at the recent level of prices and costs comes from the addition to the pine forest of 1,717.5 thousand acres of cropland and idle farmland. This additional land is in plantations on high site, mesic terrain in the coastal and piedmont regions, raising the total plantation acreage to 9,343.8 thousand acres and, in turn, the total acreage of managed pine forest to 11,302.2 thousand acres.

The acreage in the natural stand management plan, custodial plan, and the unmanageable acreage remain unchanged from the baseline 1980s outlook, as shown in Table 2. Assuming industry would be willing to pay the same stumpage prices for this additional timber supply in the future as they did in 1984 for a smaller volume, a significant expansion in the capacity of Georgia's forest products industry would be possible in the future.

The "What If" Interest Rate Outlook

Of course, it is problematical whether the Conservation Reserve Program will receive sufficient government funding to accomplish such a large planting of pine on diverted farm acres. However, even without a federal subsidy there may be a substantial increase in the acreage of the managed pine forest as farmers and other investors come to realize that Georgia's pine forest offers one of the best long run investments available in the economy.

In the late 1970s Georgia's timberland began to attract investors from around the world because it offered a hedge against the raging price inflation of that time. Since stumpage prices historically have tended by a small margin to exceed general price inflation, a forestry investment in Georgia promises to be a good hedge against future inflation. But even if the future economy is noninflationary, forestry in Georgia offers outstanding long run investment opportunities, especially if competing agricultural uses for the land are experiencing commodity price deflation as is the case today.

Neither the timber supply outlooks of the 1970s or 1980s presented here assume any future inflation of costs or stumpage prices. That is, the former outlook assumed costs and prices prevailing in 1977 would persist indefinitely into the future and the more recent outlook assumes future costs and prices will remain constant at 1984 levels. This "constant dollar" assumption requires that the interest rate applying to forestry's investment calculations be adjusted for inflation or expressed as a "real" rate of interest.

As for what the "real" rate of interest should be, the experience over the past several generations in the United States and other advanced nations is that it is approximately 3 percent annually compounded. At a rate of 3 percent annually compounded the real standard of living in these advanced nations has doubled every 25 years. This 3 percent rate is the measure of the growth in the real economy against which the growth in the volume and value of a stand of timber should be compared over a rotation period. It assumes that stumpage price increases, if any, will no more or no less than compensate for general price inflation.

Importantly, however, in the above timber supply outlooks the 3 percent rate of interest applies only to the timberland in public ownership. Since interest rates charged corporate and individual borrowers for long term debt tend to be 1 to 2 percent higher than government rates, due to the greater risk of borrower default, 4 percent and 5 percent real interest rates have been applied to the acreage cells in industry and other private ownerships.

But if one takes the view that very little of the forestry practices by private owners is financed with debt, the 3 percent real rate of interest is a better measure of the capital cost of the investment. Moreover, even if the landowners do not agree, from the standpoint of the general public interest in the efficient use of the Nation's scarce economic resources, whether by private or public agencies, the 3 percent interest rate is appropriate. Hence, the timber supply outlook in Chart 4 is designated as the "public interest" outlook.

As in the "what if" analysis where the only change in the 1980s outlook was a substitution of a $1 rent for the $18.50, $15.50, and $6.50 annual agricultural rents, the substitution of a 3 percent interest rate for the 4 and 5 percent interest rates applying above results in a substantial shift in the long run supply curve to the right of the dotted line representing the 1980s timber supply outlook of Chart 1. At all but extremely high levels of sustained annual yield and prices, the cost per MCF of supplying timber in the long run is substantially less when a 3 percent interest rate is applied to land in all ownerships. Since all other assumptions, including the level of agricultural rents, are left unchanged, this shift in the supply curve visually dramatizes the importance of the interest component of forest management costs. The recommended forest management at the long run market equilibrium between the $542/MCF or current level of stumpage prices and the timber supply curve calculated with 3 percent interest throughout is shown in Table 3.

At a 3 percent real rate of interest, the recommended pine forest is 12,659 thousand acres, 2,531 thousand acres larger than the forest recommended in the baseline 1980s timber supply outlook and 1,356 thousand acres larger than the recommended forest in the agricultural scenario. There are two reasons for the substantial increase in the acreage recommended for forest management. First, because of the reduction of interest from a 5 percent to a 3 percent rate on forestry investments by farm ownerships, it pays them to plant pines on 677 thousand acres of diverted cropland in the coastal and piedmont regions. On this much land, forestry will earn more than the $18.50 and $15.50 per acre annual agricultural rents applying in these two regions as well as the accumulated interest cost of 3 percent compounded over a 35 year period. Granted, this diversion of cropland to forestry is less than half the 1,717 thousand acre diversion to forestry in the above agricultural scenario, no rent subsidy is assumed.

A second reason for the larger forest is that a reduction in the interest rate tends to favor less intensive forestry. In this scenario the 35 year rotation was preferred to the 25 year rotations for every acreage cell or tract being processed by the model. This means that for any given tract fewer acres are harvested each year and thus more tracts are required to sustain the same annual volume of harvest from the forest as a whole. Moreover, relatively more acreage in this forest are managed under the intensive natural stand an custodial options, which require less economic resources but more time than the plantation option. The additional acres in the forest which did not come from land diversions from agriculture reflect a concurrent reduction of 1,932 thousand acres in unmanageable timberland from that of the baseline 1980s outlook.

Therefore, from the standpoint of the efficient use of our forest and other economic resouces, much more timberland is needed for forestry but relatively smaller increases in the material and human resources used in forest management are called for. At the recent price level of $542/MCF, an equilibrium volume of 1,165 million cubic feet per year is called for from the perspective of a 3 percent real interest rate. This annual yield from a forest of 12,659 thousand acres is virtually the same output as that of the forest in the above agricultural scenario, which has only 11,830 thousand acres in total but 931 thousand acres more in plantations.

Since most of the additional growing space is located in the coastal and piedmont regions, very little acreage of pine or oak-pine forest types in these regions remain in the unmanageable or

Table 3

Prescribed Management for Equilibrium between Supply and 1984 Prices
($542/MCF Level of Prices & Costs amd 1,165.4 Million Cubic Foot Volume)

(Assumes 3 percent Real Interest Rate)

	Managed Area				Unmanaged
	Plantation M Acres	Nat. Std. M Acres	Custodial M Acres	Total M Acres	Forest M Acres
Region					
Coastal	5,647.6	40.1	656.2	6,343.9	0.0
Piedmont	2,765.5	2,385.5	818.2	5,969.2	295.8
Mountain	0.0	319.7	26.0	345.7	741.6
Ownership					
Public	433.3	175.4	94.4	703.1	87.8
Industry	2,765.4	721.5	107.7	3,594.6	430.8
Other Private	5,214.4	1,848.4	1,298.3	8,361.1	518.8
Forest Type					
Longleaf-Slash	4,371.2	0.0	349.2	4,720.4	136.2
Loblolly-ShtLf	3,186.2	2,745.3	0.0	5,931.5	481.6
Oak-Pine	855.7	0.0	1,151.2	2,006.9	419.6
Physiographic Class					
Xeric	147.8	51.3	113.0	312.1	91.2
Mesic	8,151.7	2,684.7	1,256.1	12,092.5	946.2
Hydric	113.6	9.3	131.3	254.2	0.0
Site Class					
High	5,425.8	319.7	26.0	5,771.5	14.0
Medium	2,986.2	2,300.6	1,155.7	6,442.5	954.9
Low	1.1	125.0	318.7	444.8	68.5
State Total	8,413.1	2,745.3	1,500.4	12,658.8	1,037.4

Authors' Computations

surplus category. A continued loss of pine and oak-pine forest types to the invasion of hardwoods, as experienced during the interim between the last two forest surveys, therefore jeopardizes the potential for expanding the long run timber supply in an economical fashion. Moreover, since indicated volume of timber growth and harvest is 21 percent greater than that of recent years, the continued expansion of the forest industry's productive capacity and employment in Georgia is jeopardized unless the hardwood invasion of pine and oak-pine sites in the piedmont and coastal plain is arrested. Granted, the public interest is served also by the millions of acres in hardwood forest, especially in the scenic Georgia mountains. But the tradeoff for any wildlife, recreational, and other environmental benefits from the continued and irreversible invasion of pine sites by hardwoods is a substantial future economic loss to Georgia. The sacrificed potential expansion in the timber supply would sustain an increase in the capacity of Georgia's forest products industry by the equivalent of 4 to 5 world class pulp mills.

Other"What If" Implications

As indicated above, the timber supply outlooks assume that the forest will be managed in a fashion that maximizes the present net worth per acre of the various acreage cells. Present net worth is a measure of today's bare land value of timberland, assuming the land is to be subsequently managed as a plantation or natural stand management option, whichever of the three plans is most profitable. Present net worth is the amount that an investor could pay for the bare land today and still expect to earn in addition an average rate of return, e.g. the 3 percent real rate of return, on the amount he has to invest in site preparation, prescribe burning, and other recommended forest practices over the upcoming rotation. If the investor can buy the bare timberland for less than its per acre present net worth or if he already owns the land, he can expect to earn a better than average return on an investment in the recommended forest practices. Accordingly, the landowner or prospective landowner has an economic incentive to practice the recommended forest management that is greater or less depending upon the relative amount of the bare timberland's market price and its present new worth.

As compared with the prevailing perception of rural land prices in Georgia, the per acre present net worth values imputed by the above timber supply outlooks for large acreages of Georgia's timber and farmland are surprisingly high. Timberland has been traditionally viewed as the least valuable of land uses, a view encouraged by the fact that most of Georgia's existing forest grew up on abandoned farmland. Thus, as farmland prices have collapsed in recent years it may be difficult for some to visualize that the land may have significantly higher value because of its potential forestry use. Abetting the view that bare timberland must have even less value than depressed farmland has been the cooling of general price inflation and the lessening of investor demand to hold real estate as a hedge against inflation. Then, too, that several large corporate timberland owners have put their holdings on the market in recent years would not seem to be a vote of confidence on behalf of owning timberland with trees, much less bare timberland.

That owning land managed properly for forestry in Georgia may be a good long run investment can be illustrated by a final run of the model. In this timber supply outlook it is assumed both that private landowners perceive their real interest cost to be a 3 percent annual rate and that only a nominal $1 agricultural rent can be earned on the marginal and idle cropland that is potentially available to forestry.

Table 4 summarizes the acreage and per acre present net worth associated with the market equilibrium of the timber supply curve embodying these two assumptions with the current or $542/MCF level of stumpage prices. Note that this table does NOT identify the characteristics of the acreages associated with the various classes of per acre present net worth nor does it offer any estimate of current farmland or bare timberland prices with which to compare these imputed valuations. The purpose here is merely to illustrate that there may be a powerful economic motivation to expand Georgia's long run timber supply, if need be by plantation of idle and marginal cropland.

Table 4

Present Net Worth Per Acre of Georgia's Pine Forest
(Assumes 3 Percent Interest and $1 per Acre Agricultural Rent)
(1984 Prices and Costs)

Present Net Worth Per Acre	Thousand Acres
$1,000 or more	456.6
800 -- 999	1,855.7
600 -- 799	1,332.5
400 -- 599	2,860.7
200 -- 399	4,756.3
Under $200	2,437.4
Total Acres	13,699.2

Authors' Computations

A significant source of potential growth in the timber supply and Georgia's forest industry is the plantation of marginal and idle cropland.

Secondly, note that the table's findings imply that the forest industry in Georgia will expand its demand for timber significantly over the long run so long as stumpage prices remain at recent levels. This run of the model results in a market equilibrium timber volume of 1.3 billion cubic feet, one third more volume than 1982 softwood removals. Over the past decade or so, the forest industry has expanded capacity in Georgia more or less in step with the increased supply of pine timber even at slightly rising real stumpage prices. But there is no guarantee of an expanded future industry demand for stumpage of the magnitude assumed here even assuming real stumpage prices do not increase from the 1984 level.

With these important qualifications, this timber supply outlook implies a managed pine forest in Georgia of 13.7 million acres, including the 1,717 thousand acres of diverted cropland from the above agricultural "what if" scenario. The estimated aveage per acre bare land value of this pine forest is $453 an acre at 1984 prices. This pine forest includes 3,644.5 thousand acres with a bareland value of more than $600 an acre and 456.6 thousand acres with a bare land value greater than $1,000 an acre.

Summary and Conclusions

In the period between the two timber supply outlooks, 1977 to 1984, there has been a substantial increase in the long run unit costs of supplying timber from Georgia's pine forest due to general price inflation. But there was a greater increase in the level of Georgia's stumpage prices due to a growing industry capacity and timber demand. Consequently, even as the state's agricultural economy was staggering under poor crop years, growing debt, and declining commodity prices, a long run investment in the management of Georgia's pine forest was becoming more profitable. By 1984 the forest products industry demand for Georgia pine timber was pressing not only against the limit of the net annual softwood growth volume found by the 1982 forest survey but also against the volume of pine that could be supplied the industry in the long run at the 1984 level of stumpage prices. Thus, the development of Georgia's forest resource is more limited by timber supply than industry's timber demand.

The annual acreage of pine regeneration required to sustain the existing pine forest and industry demand far exceeds the annual planting acreage found by the 1982 forest survey over the preceding decade. More recently, due to a concerted effort by public and private agencies, there appears to have been sufficient annual acreage of pine plantations to sustain the existing forest. But any let down in this effort jeopardizes Georgia's existing forest economy, let alone any economic growth.

A significant source of potential growth in the timber supply and Georgia's forest industry is the plantation of marginal and idle cropland. As much as 1.7 million acres of marginal farmland could be added to the state's pine forest, expanding the long run timber supply by 22 percent at the level of 1984 costs and stumpage prices. This much potential volume would sustain an expansion of Georgia's forest industry capacity by the equivalent of 4 to 5 world class pulp mills. While it is problematical that the federal Conservation Reserve Program will be funded by an amount sufficient to allow this much farmland to be diverted to the pine forest, there is a powerful economic incentive for farmers and private investors in farmland to divert marginal farmland to the pine forest. This incentive flows from the fact that rural land values are currently very depressed relative to the current bare land value of that land under profitable forest management. By this study's analysis there may be as many as 3.6 million acres in Georgia with a present worth of more than $600 an acre for bare land, including almost a half million acres with a bare land value of $1,000 or more per acre.

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